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III. "Account of the Observations and Computations made for the purpose of ascertaining the amount of the deflection of the Plumb-Line at Arthur's Seat, and the Mean Specific Gravity of the Earth; with an account of the observed and computed amount of the Local Attraction at Arthur's Seat and at the Royal Observatory at Edinburgh." Communicated by Lieutenant-Colonel JAMES, R.E., F.R.S. &c., Superintendent of the Ordnance Survey. Received February 11, 1856.

(Abstract.)

Col. James begins by observing, that as the Royal Society has, from the very commencement of the Ordnance Survey of the United Kingdom, taken a deep interest in its progress, he has great pleasure in announcing to the Society that all the computations connected with the Primary Triangulation, the measurement of the Arcs of Meridians and the determination of the figure and dimensions of the earth are now completed, and that the account of all the operations and calculations which have been undertaken and executed is now in the press, and will shortly be in the hands of the public.

In the progress of these operations it has been found, on determining the most probable spheroid from all the astronomical and geodetic amplitudes in Great Britain, that the plumb-line is considerably deflected at several of the principal Trigonometrical Stations, and at almost every station the cause of the deflection is apparent in the configuration of the surrounding country.

The deflection of the plumb-line at Arthur's Seat is $5''\cdot1$, and at the Royal Observatory at Edinburgh it amounts to $5''\cdot63$ to the South. The unequal distribution of matter in the vicinity of these Stations—the great trough of the Firth of Forth being on the North and the range of the Pentland Hills on the South—presents an obvious cause for the deflection; but as the contoured plans of the county of Edinburgh have been published and the best attainable data acquired for estimating the amount of local attraction at the above-mentioned stations, it appeared desirable specially to investigate the matter, both on account of its scientific interest and with a

view to confirm the results arrived at from the previous investigation of all the observed latitudes. Col. James accordingly decided on having observations taken with Airy's Zenith Sector on the summit of Arthur's Seat, and at two other points near the meridian line on the North and South of that mountain, at about one-third of its altitude above the surrounding country.

The observations were made by Serjeant-Major Steel of the Royal Sappers and Miners, during the months of September and October last, and 220 double observations of stars were taken at each Station. The reductions and computations connected with these observations, as well as the computations of the local attraction at the Calton Hill, were entrusted to Captain Clarke, R.E., by whom the account now communicated of the mathematical investigation of the observed data has been drawn up.

Col. James has himself examined the geological structure of Arthur's Seat and of the whole of the county of Edinburgh, and has caused determinations to be made of the specific gravity of all the different rocks, with the view of estimating the mean specific gravity of the whole mass; but he observes, that although the geological structure of Arthur's Seat is well exposed, and its mean specific gravity, 2·75, has been employed for deducing that of the earth, viz. 5·1, still it is not a mountain he should have selected for this special object. Accordingly he was pleased by discovering—on referring, since these observations were made, to the correspondence of the Survey,—that the late Dr. Macculloch had been employed from 1814 to 1819 in examining the whole of Scotland for the purpose of selecting a mountain which, from its homogeneous structure, size, and form, would be best suited for the purpose referred to, and that he had pointed out the Stack Mountain in Sutherlandshire as admirably answering the required conditions. The transfer of the whole force of the Survey from the North of England and Scotland to Ireland, prevented the late General Colby from undertaking this investigation; but as the Survey of Scotland is now in full progress, Col. James purposes early in the spring to have the Stack Mountain and the surrounding country surveyed and contoured, and to have observations taken for determining the attraction of its mass, and he trusts by the close of the present year to lay the results before the Royal Society.

After these preliminary explanations, a detailed account is given of the mathematical investigation, and the paper, which was illustrated with plans and geological sections, and a model of Arthur's Seat, concludes with the following statement of the principal results :—

1. "The effect of the attraction of the Pentland Hills is observed in nearly equal amount at each of the three stations on Arthur's Seat.

2. "The calculated attractions of the mass of Arthur's Seat at the three stations are,—

| South Station. | Arthur's Seat. | North Station. |
|----------------|----------------|----------------|
| 2''·25 North. | 0''·34 South. | 1''·98 South. |

and, since the observed deflection at Arthur's Seat is 5''·27, the apparent effect of the Pentlands is 4''·93 at the summit of the hill.

3. "Of this deflection of 4''·93, the computed attraction due to the configuration of the ground within a radius of fifteen miles accounts for about 2''·6; and, inasmuch as we know that the igneous rocks of Arthur's Seat and the Pentland Hills have an origin at a great depth below the surface of the earth, the difference between the observed and computed attraction is probably owing in part to the high specific gravity of the mass of rock beneath them.

4. "The deflection at the Royal Observatory, Calton Hill, being 5''·63 South, exceeds that at Arthur's Seat by 0''·70. Of this deflection, 0''·60 is due to the configuration of the ground comprised within a circle of a mile and a quarter round the Observatory.

5. "The latitude of Arthur's Seat or points in the neighbourhood varies to the amount of 0''·02 between high and low water.

6. "The mean density of the earth, determined from the observations at the three stations on Arthur's Seat, is 5·14, with a probable error of $\pm \cdot 07$ due to the probable errors of the astronomical amplitudes."